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Improved Method for Aerodynamic Analysis of Wing-Body-Tail Configurations in Subsonic and Supersonic Flow

The problem:

A better method was needed for assisting in aircraft analysis.

The solution:

A new method has been developed for calculating the pressure-distribution and aerodynamic characteristics of wing-body-tail combinations in subsonic and supersonic potential flow. A computer program has been developed to perform the numerical calculations.

How it's done:

The configuration surface is subdivided into a large number of panels, each of which contains an aerodynamic singularity distribution. A constant-source distribution is used on the body panels; and a vortex distribution, having a linear variation in the streamwise direction, is used on the wing and tail panels. The normal components of velocity, induced at specified control points by each singularity distribution, are calculated and make up the coefficients of a system of linear equations, relating the strengths of the singularities to the magnitude of the normal velocities. The singularity strengths, which satisfy the boundary condition of tangential flow at the control points for a given Mach number and angle of attack, are determined by solving the system of equations using an iterative procedure. Once the singularity strengths are known, the pressure coefficients are calculated; and the forces and moments acting on the configuration are determined by numerical integration.

The new method contains a number of unique features, which are considered improvements over former methods available for solving the problem. The u , v , and w components of velocity, induced by surface distributions of sources and vortices at arbitrary points in the flow field, are derived by an extended version of a

current theory. The new method includes panels inclined to the free-stream direction in both subsonic and supersonic flow, which allows a complete-surface panel representation of the configuration and a corresponding improvement in the aerodynamic solution. In particular, the new method permits the analysis of noncircular bodies and the calculation of wing-body interference effects in the presence of body closure, two features not available previously. In addition, the use of a vortex distribution, having a linear variation in the streamwise direction, results in improved chordwise pressure distributions on wing and tail surfaces.

Notes:

1. The computer program is written in FORTRAN IV for the CDC 6600 computer; it occupies 70,000 (octal) words and operates in the overlay mode. The program requires five peripheral-storage disk files, in addition to the input and output files.
2. Inquiries concerning this program should be directed to:

COSMIC
112 Barrow Hall
University of Georgia
Athens, Georgia 30601
Reference: LAR-11305

Source: C. H. Fox
Langley Research Center
and F. A. Woodward of
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